I NEVER LIKED CHEMISTRY

a pool and spa water chemistry primer for the rest of us

taylor

the most trusted name in water testing

Introduction

As a pool or spa owner, you look forward to an invigorating swim or relaxing soak. But do you know how to tell if your water is safe for bathing? How to detect water conditions that may be harmful to the pool/spa or its equipment? What to do if it needs treatment?

Not to worry! Everything you need to understand about water quality maintenance is here in this little booklet, *I Never Liked Chemistry.* Read it to learn how to keep your water problem-free and get maximum enjoyment from your investment.

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Testing – The Cornerstone of Water Treatment

The condition of pool and spa water cannot be determined simply by looking at it. You must test the water quality routinely. Evaporation, sunlight, and contaminants introduced by the wind, rain, and bathers (body wastes and personal care products) all affect water quality. Adding treatment chemicals will also change the water's characteristics. To prevent illness as well as damage to the pool or spa and its equipment, you must diligently monitor two important factors, **sanitation** and **water balance,** using a reliable liquid test kit or test strip. Your test results will determine when and how much chemical treatment is necessary to restore the water to a sparkling clean state.

"The key to safe water is regular testing. Set up a testing schedule and stick to it!"

The most useful test kits determine the level of active sanitizer (generally, free chlorine or bromine); measure the three main components of water balance (pH, total alkalinity, and calcium hardness); and indicate target values. When chemistry parameters are all within their ideal range, usually no further action is needed—your water is properly sanitized and balanced. However, when even one factor is outside the acceptable range, it becomes necessary to adjust the chemistry or harmful water conditions can occur. How do you know what adjustments to make? You have three choices:

Service company: Hire professionals to service your pool on a regular schedule. In addition, buy a basic test kit or test strip that allows you to monitor and adjust the sanitizer and pH between service visits because these parameters can change quickly.

Local Dealer: Again, buy a basic test kit or test strip to monitor and adjust the sanitizer level and pH yourself, but periodically bring a water sample to your local pool/spa supplies store, too, for a complete analysis and their expert treatment recommendations.

Do it yourself: Buy a comprehensive test kit or test strip (namely chlorine or bromine, pH, acid/base demand, total alkalinity, calcium hardness, and cyanuric acid if you're sanitizing with chlorine that's been "stabilized" to slow down its destruction by sunlight). Then, follow the instructions for determining treatment dosages. Seek expert help as you need it and when opening or closing your pool.

Taylor Technologies manufactures testing products appropriate for all three scenarios, and these are available at better pool supplies stores nationwide. Taylor's website, www.taylortechnologies.com, is also a valuable resource for pool and spa owners. It offers topics beyond the scope of this booklet, computerized water analysis, and much more!

10 Tips on Storing and Using Your Liquid Test Kit or Test Strips

- Keep out of children's reach at all times.
- Store in a cool, dark place.
- Store away from other chemicals.
- Follow directions precisely.
- Test at the specified depth, away from return lines.
- Rinse test cells before and after each use.
- For uniform drop size, hold the reagent bottle in a vertical position when dispensing.
- Replace caps promptly to keep air and humidity out. Do not interchange reagent caps.
- Compare colors in daylight, facing away from the sun, without sunglasses.
- Start each swim season with fresh testing supplies.

Volume – The Key to Determining Dosages

You'll need to know your pool or spa's volume in gallons or liters to determine the amount of treatment chemicals to add. Knowing the capacity will also allow you to ensure your pump and filter are properly sized to circulate and clean the water effectively. Your builder or dealer should be able to tell you the pool or spa's volume, or you can calculate it using one of the formulas below. If the pool has an irregular shape or sloping sides, your pool supplies dealer can help you determine its capacity.

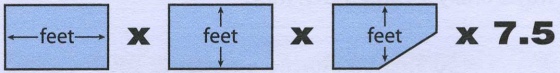
1st Calculate Average Depth (using Feet or Meters)

(Depth at Shallow End + Depth at Deep End) ÷ 2 = Average Depth

2nd Calculate Pool/Spa Volume

Rectangular/Square Formula:

Length x Width x Average Depth x 7.5 = Volume in U.S. Gallons*

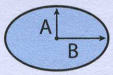


Oval Formula:

Area = A x B x 3.14

Gallons = Area x Avg. Depth x 7.5

Liters = Area x Avg. Depth x 1000



Round Formula:

Area = R x R x 3.14

Gallons = Area x Avg. Depth x 7.5

Liters = Area x Avg. Depth x 1000

Metric Calculation for Rectangular/Square Pools/Spas:

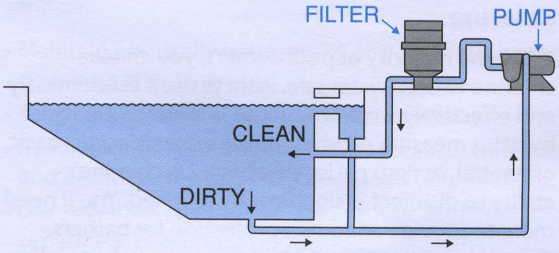
Length x Width x Average Depth x 1000 = Volume in Liters

*1 U.S. gallon = 3.785 liters

Circulation System – Chemicals Can't Do It Alone

Your pool or spa has a circulation system, consisting of a pump and filter, that's responsible for distributing treatment chemicals throughout the pool/spa and removing suspended solids such as pollen, dirt, algae, and insects. The circulation system is also responsible for distributing heated water uniformly.

To be effective, the pump and filter must be sized correctly for the volume of water to be moved; run long enough each day to accomplish their mission; and maintained in proper working order. Follow the pump and filter manufacturer's maintenance recommendations and if mechanical problems arise, get professional advice promptly.



"Remember...just as a three-legged stool can't stand if a leg is missing, your pool or spa can't achieve proper water quality without the trio of pump, filter, and chemical treatment working together in harmony."

Sanitation – Keeping Bathers Healthy

Sanitary water is free from infection- and disease-causing microbes like bacteria, viruses, and yeasts. It's also free from algae that can shelter germs, cause falls, and spoil the appearance of water. Water will not stay sanitary by itself. It requires the regular addition of a sanitizer (disinfectant) to kill these microorganisms, plus an oxidizer to destroy impurities the filter doesn't catch like perspiration, urine, sunscreen, dust, and pollen. Some sanitizers, notably chlorine, are oxidizers too. (It's estimated that 90 percent of chlorine in a well-used pool is working to oxidize impurities, leaving only 10 percent to protect swimmers from germs.) But not all sanitizers are oxidizers, nor are all oxidizers sanitizers. The importance of this will be clear later in this chapter.

Chlorine

If, like the majority of pool owners, you choose chlorine to keep water safe, learn to use it economically and effectively. Economical use is largely influenced by pH, a measure of whether the water is acidic, basic, or neutral. At high pH levels, above 7.8, chlorine's ability to disinfect is significantly reduced. You'll need more to provide adequate protection for bathers. But, at lower pH levels, 7.4 to 7.6, chlorine's disinfecting ability is enhanced. Thus, in the target pH range, you'll get more disinfection for your money.

Chlorine exists in your pool or spa in two basic forms: "free" and "combined" chlorine. When you add chlorine to your water, it becomes the powerful sanitizer and oxidizer called free chlorine. Free chlorine will react immediately with contaminants in the water until its fighting power is all used up. This reacted chlorine is called combined chlorine; it's smelly and irritating to bathers. Make sure to always have enough free chlorine to provide around-the-clock disinfection protection.

The UV rays in sunlight can destroy the chlorine in outdoor pools rapidly. The sanitizers dichlor and trichlor already contain a chlorine stabilizer called "cyanuric acid" (CYA), or CYA can also be added separately.

Chlorine Facts

Ideal	Potential Problems:		
	Free Chlorine Too Low	Free Chlorine Too High	Combined Chlorine Too High
Free Chlorine 2.0 – 4.0 ppm for pools *and* spas **Combined Chlorine** 0 ppm for pools *and* spas **Test Frequency** daily, or more often as high bather load demands	• risk of transmitting infections and diseases • risk of algae growth	• uneconomical use of disinfectant • bleaching of hair, swimsuits, and pool/spa surfaces	• irritates bathers' eyes and mucous membranes • causes strong "chlorine" odor

Remember the following when using chlorine as a sanitizer:

- Maintain pH ideally between 7.4 and 7.6 to support chlorine's effectiveness.
- Keep free chlorine at recommended levels.
- Remove combined chlorine before it causes odors and irritation (see page 10, Breakpoint Chlorination).
- Use stabilized chlorine, or add cyanuric acid separately, to outdoor pools.

Testing: Test daily. Chlorine levels are typically determined by color comparison. You dip a test strip into a sample of your pool or spa water that's been collected in a clean container, or add reagents (testing chemicals) to a water sample as specified in the test instructions. You then match the color that develops to the provided color standards to read the chlorine concentration. It is important to understand not all testing products can distinguish free chlorine from combined chlorine. Read the label carefully! A test for "total" chlorine only (the sum of free and combined chlorine) is not recommended. A test for

free chlorine alone is preferable to determine both free chlorine and combined chlorine.

Outdoor pools using stabilized chlorine should be tested several times during the swim season to keep the CYA level between 30 to 50 ppm. Some test strips have a CYA test and more advanced liquid kits do too. Or, ask your chemical supplier to test a sample of your water for CYA.

Adjusting: You can raise the free chlorine level by adding any chlorine product formulated for use in a pool or spa. First, determine the existing chlorine concentration. Next, read the treatment product's label to find the percentage of available chlorine (its sanitizing strength). Then refer to the treatment tables (pages 23-25) to determine how much to add to raise the chlorine level to the recommended range.

"Stay safe! Always add chlorine to water—NEVER add water to chlorine!"

Breakpoint Chlorination: The procedure for removing combined chlorine is called "breakpoint chlorination." First, determine the combined chlorine level. Next, multiply that number by 10. The result is the breakpoint dosage of free chlorine you must add all at once to remove the combined chlorine. Consult the treatment tables (pages 23-25) to determine how much chlorine product to add. Chlorinating to the calculated breakpoint will also remove any organic contaminants through oxidation. Do not reenter the water until the free chlorine level drops below 5 parts per million (ppm).

Superchlorination: Superchlorinating to 30 ppm will eliminate a green algae bloom. Note that unless the breakpoint is reached, more combined chlorine could be created—making the problem worse.

"Smell 'chlorine'? That's a sign you need to remove the combined chlorine that's built up in your water by employing breakpoint chlorination."

Shocking: The terms "shocking" and "superchlorination" are sometimes used interchangeably with chlorine-based products to describe the oxidizing action that will cleanse a pool or spa of organic contaminants. But you'll recall that not all oxidizers are also sanitizers, meaning they won't kill harmful bacteria and other microbes.

To keep the distinction, let's call oxidizers that don't sanitize "shocks" or "shock treatments." The most widely used is a chemical called potassium monopersulfate. Some pool and spa owners shock water when it's cloudy to destroy environmental debris and bather wastes. Still others prefer not to wait for problems to arise; they shock regularly as preventive maintenance. Their logic is that by oxidizing routinely they're ensuring the sanitizer in the water is freed up for its highest and best use, killing infection-causing microorganisms.

Dechlorination: Sometimes you may want to lower the chlorine level or "dechlorinate." Sodium thiosulfate and sodium sulfite, two chlorine neutralizers, are commonly employed for this purpose. Your chemical supplier can help you determine how much to use.

Bromine

Bromine is a powerful sanitizer, but it is not quite as effective an oxidizer as chlorine. Unlike chlorine, bromine is able to sanitize in both its free and combined forms, and combined bromine does not produce the offensive odor associated with combined chlorine. In addition, bromine is effective over a much wider pH range than chlorine. At present there is no effective protection from UV degradation on the market for bromine. For this reason, most pools and spas on bromine are indoors.

Bromine Facts		
Ideal	**Potential Problems:**	
	Bromine Too Low	**Bromine Too High**
2.0 – 3.0 ppm for pools 2.0 – 4.0 ppm for spas **Test Frequency** daily, or more often as high bather load demands	• risk of transmitting infections and diseases • risk of algae growth	• uneconomical use of disinfectant

Testing: The test for bromine is similar to the test for chlorine although the target range is different. **Check the level daily.**

Adjusting: Bromine treatments are sold as tablets, granules, and solutions. Some of these have the second oxidizer built into the product, others require a separate addition (so-called "two-part systems"). Our suggestion is to follow the product manufacturer's recommendations when making adjustments or check with your chemical supplier.

Other Sanitizers

Alternatives to traditional applications of chlorine and bromine have increased in popularity in recent years, but the number of residential pools and spas that employ these is still relatively small:

Chlorine Generators (using salt): These systems produce chlorine from salt water through electrolysis. There's no need to handle a chlorine product—only ordinary salt (sodium chloride). Taylor offers tests to monitor both the salt content of the water and the chlorine level.

Ozone Generators: UV and corona-discharge units both produce ozone, an extremely strong and fast-acting sanitizer and oxidizer. Highly unstable, it breaks down too quickly to provide full-time protection for bathers. Therefore, ozone must be paired with lower levels of chlorine or bromine. Use our low-range comparator for testing these residuals.

Copper/Silver Ionization Systems: Silver and copper are two of nature's most effective algaecides. Modern systems run a low-voltage current between a silver electrode and a copper electrode, producing charged particles that will eliminate any possible algae growth. However, copper has no sanitizing capabilities and silver has very limited biocidal properties. Because of this, a small amount of chlorine is added to provide a constant level of sanitation in the water. Bromine should not be used with these systems. Periodic shocking is also required. Taylor offers kits to monitor copper as recommended by the manufacturers, pH (to prevent metal stains), low-level chlorine, and potassium monopersulfate shock.

Biguanide (PHMB): Truly an alternative sanitizer, biguanide eliminates the need for chlorine and bromine entirely. It is used with a supplemental oxidizer (hydrogen peroxide) and a PHMB-suitable (quat-based) algaecide. It is incompatible with chlorine, bromine, ozone, ionization systems, monopersulfate, and copper-based algaecides. Taylor offers simple "drop tests" for biguanide and hydrogen peroxide that depend on seeing a dramatic color change in the treated sample.

Balanced Water – Protecting Your Investment

Balanced water is the second major concern of pool and spa owners. You balance your water to prevent material damage from corrosion and scaling.

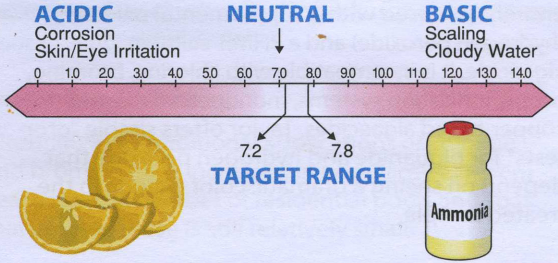
> ***"Balanced water will neither corrode nor scale surfaces and equipment."***

Corrosion is an eating away of a material, like plaster or metal pipes and fixtures. Scaling results in unsightly, rough-to-the-touch deposits on surfaces and blockages in your circulation system. Heaters are especially susceptible to corrosion and scaling.

Because these conditions can lead to costly repair bills, it is very important to keep water in balance. This is achieved by managing three **interrelated** factors—pH, total alkalinity, and calcium hardness. Remember that a change in one factor can affect the others.

pH

Measured on a scale that runs from 0 to 14, pH indicates whether water is acidic, neutral, or basic (alkaline). A pH equal to 7.0 is neutral, a pH below 7.0 is acidic, and a pH above 7.0 is basic. For comparison, lemons have a pH of 2.3, while household ammonia is 11.8, and tears are about 7.5.



Water with low pH will cause corrosion, while water with high pH will cause scaling. Also, the higher the pH, the less effective chlorine is at disinfecting. Ideally, the pH of pool and spa water should be 7.4 to 7.6. This is the best compromise between bather comfort, chlorine efficiency, and the potential for material damage.

pH Facts		
Ideal	**Potential Problems:**	
	pH Too Low	**pH Too High**
7.4 – 7.6 for pools *and* spas **Test Frequency** daily	• pits concrete, wrinkles vinyl liners, corrodes equipment	• crusty deposits (scale) may form on contact surfaces
	• metal stains may appear	• may contribute to cloudy water
	• promotes chlorine loss	• poor chlorine disinfection
	• irritates bathers' skin and eyes	• irritates bathers' skin and eyes

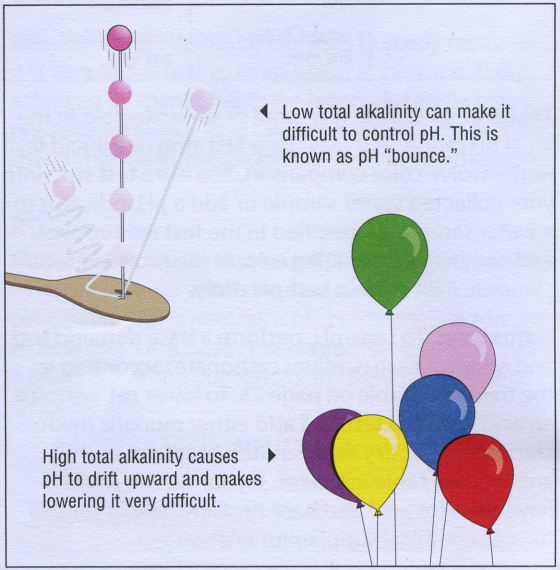
Testing: To ensure your pool or spa water falls in the ideal pH range, you may use a test strip or a liquid test. Both involve color comparison. You dip a test strip into your collected water sample or add a pH indicator to a water sample as specified in the test instructions, and compare the resulting color to the provided color standards. **Be sure to test pH daily.**

Adjusting: To raise pH, perform a base demand test and add soda ash (sodium carbonate) according to the treatment table on page 23. To lower pH, perform an acid demand test and add either muriatic (hydrochloric) acid or dry acid (sodium bisulfate) as the appropriate table indicates. If your test kit doesn't have tests for acid and base demand, take a sample to your chemical supplier for analysis.

Remember, always bring the water's total alkalinity into the recommended range before adjusting pH. Contact your pool/spa supplies store for guidance if you are inexperienced.

Total Alkalinity

Total alkalinity is important to pool and spa owners because of its great effect on pH. The simplest definition is the amount of alkaline materials (carbonates, bicarbonates, and hydroxides) in the water. When total alkalinity is low, pH is impossible to control. It will bounce around when treatment chemicals are added to the water. This can lead to any of the problems listed in the pH chart. Not fixing the root cause of pH bounce—low total alkalinity—will cause you to spend time and money constantly adjusting pH. High total alkalinity causes pH to drift upward or freeze in place and makes lowering it very difficult. You will need to apply an unusually large amount of pH adjuster or risk all the problems associated with high pH.


Low total alkalinity can make it difficult to control pH. This is known as pH "bounce."
High total alkalinity causes pH to drift upward and makes lowering it very difficult.

To protect your pool or spa's surface and equipment and to save money on treatment chemicals, always maintain the correct total alkalinity for your sanitizer type:

- 80 to 100 ppm in water sanitized with calcium hypochlorite, lithium hypochlorite, or sodium hypochlorite
- 100 to 120 ppm in water sanitized with dichlor, trichlor, or bromine

(Seek further professional advice when using alternative sanitizers.)

Total Alkalinity Facts		
Ideal	**Potential Problems:**	
	Total Alkalinity Too Low	**Total Alkalinity Too High**
80 – 120 ppm depending upon sanitizer used **Test Frequency** weekly	• pH difficult to stabilize; it "bounces" • damage from corrosion • metal stains may appear	• pH difficult to adjust • cloudy water • damage from scaling

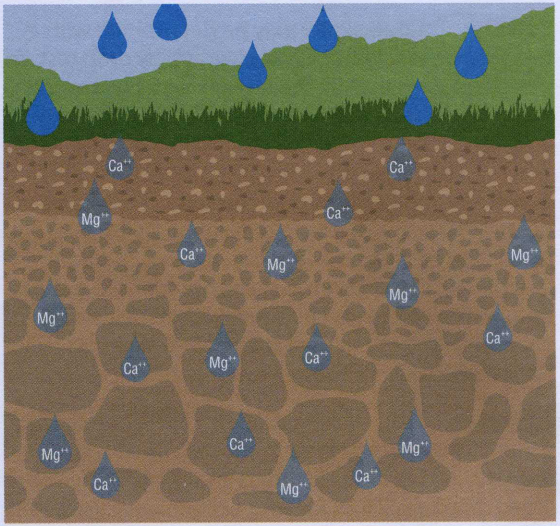
Testing: Total alkalinity may be determined with a test strip or, for even greater accuracy, by drop test. To perform a drop test, fill the test cell with pool or spa water, dechlorinate the sample with thiosulfate, and add the total alkalinity indicator. The solution will turn green. Then, holding the dropper bottle vertically, add drops one at a time until the color changes from green to gray and finally to red, counting drops as you go. Finally, multiply the number of drops of titrant used by the factor given in the instructions to get ppm of total alkalinity. **Test total alkalinity weekly.** If your test kit does not measure total alkalinity, ask your local dealer to run this analysis for you.

Adjusting: Total alkalinity can be raised with baking soda (sodium bicarbonate), or lowered with either muriatic acid or dry acid. Adjustment tables are provided on pages 24-25 for your convenience. However, because total alkalinity adjustments can also alter the water's pH, we recommend consulting with your chemical supplier before attempting this yourself.

Calcium Hardness

"Hard" water contains high levels of calcium and magnesium salts, referred to as total hardness. Homes supplied with hard water commonly have a water softener installed to improve bathing, dishwashing, clothes laundering, and cooking, and also to extend the life of the water heater and other appliances. In pool and spa water maintenance, only the level of dissolved calcium is important.

Water with low calcium hardness becomes aggressive and tries to obtain more by dissolving it from plaster, concrete, grout, and other contact sources. On the other hand, water with high calcium hardness will be cloudy, and you may experience rough and scaly surfaces, clogged filters and piping, and inefficient heating.



As water runs across the earth's surface and percolates through the ground it dissolves everything in its path. The calcium and magnesium salts picked up in this way constitute your water supply's "hardness." The term derives from the difficulty of making soap suds with this mineral-laden water.

Calcium Hardness Facts		
Ideal	**Potential Problems:**	
	Calcium Hardness Too Low	**Calcium Hardness Too High**
200 – 400 ppm for pools 150 – 250 ppm for spas **Test Frequency** monthly	• plaster, concrete, and grout may be damaged • may lead to equipment corrosion	• may contribute to cloudy water • crusty deposits (scale) may form on contact surfaces

Testing: While there are test strips available for determining total hardness, calcium hardness is monitored with a drop test. To measure, fill a test cell with water and add a buffer and indicator. This will turn the sample red. Next, add the calcium hardness reagent, counting each drop, until the color changes from red to blue. At this point, multiply the number of drops used by the factor in the instructions to determine calcium hardness in ppm. To avoid expensive repairs due to aggressive or scaling water, **test calcium hardness monthly.**

> ***'Parts per million' is a way to describe the concentration of a substance in a liquid–like calcium hardness in pool water.***

Adjusting: Raise calcium hardness easily by adding calcium chloride. The table on page 25 provides dosages to achieve the desired increase. You cannot, however, decrease calcium hardness by adding a chemical treatment. Calcium hardness can only be decreased by partially draining the pool/spa and refilling it with water having a lower calcium content.

Special Considerations for Spa Owners

While the information in this book applies to both pools and spas, there are some special considerations for spa owners due to the "hot tub's" higher temperature and smaller volume.

Higher Temperature Means	Smaller Volume Means
• greater potential for skin infections • greater tendency for scale formation • evaporation causes fast total dissolved solids (TDS) accumulation • perspiration and body oils expelled more rapidly • faster chemical reactions deplete treatments rapidly	• "teaspoon chemistry" needed for treatment chemical additions • extremely heavy bather loads deplete sanitizer reserves rapidly • pH fluctuations • faster turnover rate needed

Routinely testing, sanitizing, and balancing your spa water should allow you to avoid problems. An additional preventive step is to periodically drain and refill your spa with fresh water. You can use the following formula to calculate how many days you should wait between completely emptying and refilling your spa. "Daily Bather" is defined as a 15-minute soak.

$$\text{\# of Days} = \frac{\text{1/3 Volume (Gallons)}}{\text{Max. \# of Daily Bathers}} \quad \text{or} \quad \frac{\text{Volume (Liters)}}{\text{10 x Max. \# of Daily Bathers}}$$

Troubleshooting Your Water

It's always easier to prevent a water problem than to fix one, so test and treat your water regularly. This table summarizes common symptoms of problem water. If you notice any of these, visit your chemical supplier for a comprehensive water analysis and a suggested treatment.

Troubleshooting Pools & Spas		
Symptom	**Possible Cause(s)**	**Potential Solution**
Plaster etching, concrete pitting, grout dissolving.	Unbalanced water.	Have pH, total alkalinity & calcium hardness levels tested. Balance water with treatment chemicals recommended by your supplier.
Scale on walls & fixtures. (Common in new inground pools.)		
Corrosion of metal fixtures in contact with pool water. Rust & copper stains.	Unbalanced water.	Have pH, total alkalinity & calcium hardness levels tested. Balance water with treatment chemicals recommended by your supplier. Add chelating or sequestering agent per instructions to prevent more stains.
Bleached hair or bathing suits. Eye irritation.	Excessive chlorine.	Add sodium sulfite or sodium thiosulfate to neutralize.
Eye irritation &/or itchy skin. Water has foul odor. Complaints of "too much chlorine" in water.	High combined chlorine, low free chlorine.	Adjust pH to 7.4 – 7.6.* Perform breakpoint chlorination to eliminate combined chlorine. Do not reenter water until free chlorine level drops below 5 ppm.
Skin/eye irritation.	Improper pH.	Adjust pH to 7.4 – 7.6.*
Hazy, cloudy water. No sparkle.	Early algae growth.	Superchlorinate or shock.
	Poor filtration.	Check filter for proper operation.
	High pH.	Lower pH to 7.4 – 7.6.*
	High total alkalinity.	Lower total alkalinity to 80 – 120 ppm.
Red-brown water.	Iron.	Seek expert advice on source of metals & treatment solution.
Purple-black water.	Manganese.	
Blue-green water.	Copper.	
Green, slippery pool surfaces & cloudy or green water. Black spotty patches on pool surfaces. Yellow powdery deposits on shady side of pool.	Algae.	Adjust pH to 7.4 – 7.6.* Superchlorinate to 30 ppm. Concrete: Brush sides & bottom with stainless steel brush. Vinyl liner: Use soft nylon brush. Repeat if necessary. Use algaecides.

* Always bring total alkalinity into recommended range before adjusting pH.

Treatment Tables

Once you have performed tests for sanitizer, pH, acid or base demand, total alkalinity, and calcium hardness and have decided you need to treat your water, you can use the following tables to determine the correct amount of treatment chemical. Turn to the appropriate table and, using the column with the correct volume of water, locate the recommended dosage.

By using combinations of various columns from the following tables, you can determine how much chemical to use in a pool or spa of any size. For example, in Table 1, to determine how much chlorine to add to a 20,000-gallon pool, simply look at the row for 10,000 gallons, locate the value for the % available chlorine product you are using, and multiply the number shown by 2. Similarly, for a 500-gallon spa, look at the row for 100 gallons, determine the appropriate column value for the % available chlorine product you are using, and multiply the number shown by 5.

To Raise Chlorine Level by 1 ppm

Volume of Water (gallons / liters)	% AVAILABLE CHLORINE IN PRODUCT					
	10%	35%	45%	65%	75%	90%
100 gal / 400 L	0.13 fl oz / 4.00 mL	0.04 oz / 1.14 g	0.03 oz / 0.89 g	0.02 oz / 0.62 g	0.02 oz / 0.56 g	0.02 oz / 0.44 g
1,000 gal / 4,000 L	1.28 fl oz / 40.0 mL	0.38 oz / 11.4 g	0.30 oz / 8.89 g	0.21 oz / 6.15 g	0.20 oz / 5.63 g	0.15 oz / 4.44 g
10,000 gal / 40,000 L	12.8 fl oz / 400 mL	3.82 oz / 114 g	2.97 oz / 88.9 g	2.05 oz / 61.5 g	1.77 oz / 56.3 g	1.48 oz / 44.4 g

Superchlorination for Algae Removal (30 ppm Chlorine)

Volume of Water (gallons / liters)	% AVAILABLE CHLORINE IN PRODUCT					
	10%	35%	45%	65%	75%	90%
100 gal / 400 L	3.84 fl oz / 120 mL	1.14 oz / 34.3 g	0.89 oz / 26.7 g	0.62 oz / 18.5 g	0.57 oz / 17.0 g	0.45 oz / 13.3 g
1,000 gal / 4,000 L	1.20 qt / 1.20 L	11.4 oz / 343 g	8.90 oz / 267 g	6.17 oz / 185 g	5.66 oz / 170 g	4.45 oz / 133 g
10,000 gal / 40,000 L	3.00 gal / 12.0 L	7.15 lb / 3.43 kg	5.56 lb / 2.67 kg	3.85 lb / 1.85 kg	3.53 lb / 1.70 kg	2.78 lb / 1.33 kg

To Raise pH with Soda Ash (Sodium Carbonate – 100%)

Volume of Water (gallons / liters)	DROPS OF BASE DEMAND REAGENT ADDED				
	1	2	3	4	5
100 gal / 400 L	0.05 oz / 1.54 g	0.10 oz / 3.07 g	0.15 oz / 4.61 g	0.21 oz / 6.14 g	0.26 oz / 7.68 g
1,000 gal / 4,000 L	0.51 oz / 15.4 g	1.03 oz / 30.7 g	1.54 oz / 46.1 g	2.05 oz / 61.4 g	2.56 oz / 76.8 g
10,000 gal / 40,000 L	5.13 oz / 154 g	10.3 oz / 307 g	15.4 oz / 461 g	1.28 lb / 614 g	1.60 lb / 768 g

To Raise Chlorine Level by 1 ppm

Volume of Water (gallons / liters)	% AVAILABLE CHLORINE IN PRODUCT					
	10%	35%	45%	65%	75%	90%
100 gal / 400 L	0.13 fl oz / 4.00 mL	0.04 oz / 1.14 g	0.03 oz / 0.89 g	0.02 oz / 0.62 g	0.02 oz / 0.56 g	0.02 oz / 0.44 g
1,000 gal / 4,000 L	1.28 fl oz / 40.0 mL	0.38 oz / 11.4 g	0.30 oz / 8.89 g	0.21 oz / 6.15 g	0.20 oz / 5.63 g	0.15 oz / 4.44 g
10,000 gal / 40,000 L	12.8 fl oz / 400 mL	3.82 oz / 114 g	2.97 oz / 88.9 g	2.05 oz / 61.5 g	1.77 oz / 56.3 g	1.48 oz / 44.4 g

Superchlorination for Algae Removal (30 ppm Chlorine)

Volume of Water (gallons / liters)	% AVAILABLE CHLORINE IN PRODUCT					
	10%	35%	45%	65%	75%	90%
100 gal / 400 L	3.84 fl oz / 120 mL	1.14 oz / 34.3 g	0.89 oz / 26.7 g	0.62 oz / 18.5 g	0.57 oz / 17.0 g	0.45 oz / 13.3 g
1,000 gal / 4,000 L	1.20 qt / 1.20 L	11.4 oz / 343 g	8.90 oz / 267 g	6.17 oz / 185 g	5.66 oz / 170 g	4.45 oz / 133 g
10,000 gal / 40,000 L	3.00 gal / 12.0 L	7.15 lb / 3.43 kg	5.56 lb / 2.67 kg	3.85 lb / 1.85 kg	3.53 lb / 1.70 kg	2.78 lb / 1.33 kg

To Raise pH with Soda Ash (Sodium Carbonate – 100%)

Volume of Water (gallons / liters)	DROPS OF BASE DEMAND REAGENT ADDED				
	1	2	3	4	5
100 gal / 400 L	0.05 oz / 1.54 g	0.10 oz / 3.07 g	0.15 oz / 4.61 g	0.21 oz / 6.14 g	0.26 oz / 7.68 g
1,000 gal / 4,000 L	0.51 oz / 15.4 g	1.03 oz / 30.7 g	1.54 oz / 46.1 g	2.05 oz / 61.4 g	2.56 oz / 76.8 g
10,000 gal / 40,000 L	5.13 oz / 154 g	10.3 oz / 307 g	15.4 oz / 461 g	1.28 lb / 614 g	1.60 lb / 768 g

To Lower pH with Muriatic Acid (Hydrochloric Acid – 20° Baumé)

Volume of Water (gallons / liters)	DROPS OF ACID DEMAND REAGENT ADDED				
	1	2	3	4	5
100 gal / 400 L	0.09 fl oz / 2.86 mL	0.18 fl oz / 5.73 mL	0.28 fl oz / 8.59 mL	0.37 fl oz / 11.5 mL	0.46 fl oz / 14.3 mL
1,000 gal / 4,000 L	0.92 fl oz / 28.6 mL	1.83 fl oz / 57.3 mL	2.75 fl oz / 85.9 mL	3.67 fl oz / 115 mL	4.58 fl oz / 143 mL
10,000 gal / 40,000 L	9.16 fl oz / 286 mL	1.15 pt / 573 mL	1.72 pt / 859 mL	1.15 qt / 1.15 L	1.43 qt / 1.43 L

To Lower pH with Dry Acid (Sodium Bisulfate – 93.2%)

Volume of Water (gallons / liters)	DROPS OF ACID DEMAND REAGENT ADDED				
	1	2	3	4	5
100 gal / 400 L	0.12 oz / 3.69 g	0.25 oz / 7.38 g	0.37 oz / 11.1 g	0.49 oz / 14.8 g	0.62 oz / 18.5 g
1,000 gal / 4,000 L	1.23 oz / 36.9 g	2.46 oz / 73.8 g	3.70 oz / 111 g	4.93 oz / 148 g	6.16 oz / 185 g
10,000 gal / 40,000 L	12.3 oz / 369 g	1.54 lb / 738 g	2.31 lb / 1.11 kg	3.08 lb / 1.48 kg	3.85 lb / 1.85 kg

To Raise Total Alkalinity with Baking Soda (Sodium Bicarbonate – 100%)

Volume of Water (gallons / liters)	DESIRED INCREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.22 oz / 6.71 g	0.45 oz / 13.4 g	0.67 oz / 20.1 g	0.90 oz / 26.9 g	1.12 oz / 33.6 g
1,000 gal / 4,000 L	2.24 oz / 67.1 g	4.48 oz / 134 g	6.72 oz / 201 g	8.97 oz / 269 g	11.2 oz / 336 g
10,000 gal / 40,000 L	1.40 lb / 671 g	2.80 lb / 1.34 kg	4.20 lb / 2.01 kg	5.60 lb / 2.69 kg	7.00 lb / 3.36 kg

To Lower Total Alkalinity with Muriatic Acid (Hydrochloric Acid – 20° Baumé)

Volume of Water (gallons / liters)	DESIRED DECREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.26 fl oz / 7.99 mL	0.51 fl oz / 16.0 mL	0.77 fl oz / 24.0 mL	1.02 fl oz / 32.0 mL	1.28 fl oz / 39.9 mL
1,000 gal / 4,000 L	2.56 fl oz / 79.9 mL	5.11 fl oz / 160 mL	7.67 fl oz / 240 mL	10.2 fl oz / 320 mL	12.8 fl oz / 399 mL
10,000 gal / 40,000 L	1.60 pt / 799 mL	1.60 qt / 1.60 L	2.40 qt / 2.40 L	3.20 qt / 3.20 L	3.99 qt / 3.99 L

To Lower Total Alkalinity with Dry Acid (Sodium Bisulfate – 93.2%)

Volume of Water (gallons / liters)	DESIRED DECREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.34 oz / 10.3 g	0.69 oz / 20.6 g	1.03 oz / 30.9 g	1.37 oz / 41.2 g	1.71 oz / 51.5 g
1,000 gal / 4,000 L	3.44 oz / 103 g	6.87 oz / 206 g	10.3 oz / 309 g	13.7 oz / 412 g	1.07 lb / 515 g
10,000 gal / 40,000 L	2.15 lb / 1.03 kg	4.30 lb / 2.06 kg	6.45 lb / 3.09 kg	8.59 lb / 4.12 kg	10.7 lb / 5.15 kg

To Raise Calcium Hardness with Calcium Chloride – 77%

Volume of Water (gallons / liters)	DESIRED INCREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.19 oz / 5.76 g	0.39 oz / 11.5 g	0.58 oz / 17.3 g	0.77 oz / 23.0 g	0.96 oz / 28.8 g
1,000 gal / 4,000 L	1.92 oz / 57.6 g	3.85 oz / 115 g	5.77 oz / 173 g	7.69 oz / 230 g	9.61 oz / 288 g
10,000 gal / 40,000 L	1.20 lb / 576 g	2.40 lb / 1.15 kg	3.61 lb / 1.73 kg	4.81 lb / 2.30 kg	6.01 lb / 2.88 kg

Key Values to Remember – APSP Guidelines

The table below presents target ranges for important water chemistry parameters. These guidelines were last updated in 2011 by the Association of Pool & Spa Professionals. These values are generally accepted by professionals in the pool and spa market, including Taylor Technologies.

Water Quality Guidelines†				
Parameter	Minimum	Ideal	Maximum	Who
Free Chlorine, ppm	1.0	2.0 – 4.0	None given*	Pools, Waterparks
	2.0	2.0 – 4.0	None given*	Spas
Combined Chlorine, ppm	0	0	0.2	Pools, Waterparks
	0	0	0.5	Spas
Total Bromine, ppm	1.0	2.0 – 3.0	None given*	Pools, Waterparks
	2.0	2.0 – 4.0	None given*	Spas
PHMB, ppm	30	30 – 50	50	All types
pH	7.2	7.4 – 7.6	7.8	All types
Total Alkalinity, ppm as $CaCO_3$	60	80 – 100** 100 – 120***	180	All types
Total Dissolved Solids, ppm	NA	NA	1,500 over start-up****	All types
Calcium Hardness, ppm as $CaCO_3$	150	200 – 400	1,000	Pools, Waterparks
	100	150 – 250	800	Spas
Visible Algae	None	None	None	All types
Cyanuric Acid, ppm	10	30 – 50	100	All types
Temperature, °F	Personal preference	78° – 94°F	104°F	Pools
	Personal preference	Personal preference	104°F	Spas
Ozone (in air), ppm	-	-	0.1 over 8 hr. time wtd. avg.	All types
ORP in mV	650	-	-	All types

† These commonly accepted chemical parameters do not supersede product label directions or local or state codes and regulations.

* U.S. EPA maximum of 4.0 ppm chlorine/8.0 ppm bromine is noted.

** For calcium hypochlorite, lithium hypochlorite, or sodium hypochlorite.

*** For sodium dichlor, trichlor, chlorine gas, or bromine.

**** Including inorganic salt added.

Your Pool/Spa Profile

Pool/Spa Shell

Type of Finish _____

Shape _____

Capacity _____
(in U.S. gallons - see pg. 6)

Make/Model _____

Supplier/Installer _____
(name)

_____
(address)

_____
(telephone number)

Date Completed/Installed _____

Heater

Type _____

Serial Number _____

Make/Model _____

Filter

Type _____

Make/Model _____

Backwash Pressure _____

Clean Start-up Pressure _____

Pump

Make/Model _____

Motor Make/Model _____

Hours of Operation _____

Horsepower _____

I Never Liked Chemistry is written for the millions of homeowners with pools and spas in their backyard who recognize the importance of hygienic water but are intimidated by the chemistry involved in testing and treating it. At Taylor we believe:

- Water chemistry problems are easier to avoid than to correct.
- Proper water treatment begins with accurate water testing.
- An educated consumer will appreciate the value in Taylor's testing products.
- You *will* be able to master this subject!

This swim season, spend more time enjoying your pool or spa and less time maintaining it by testing regularly with a Taylor-made water test kit or test strip. Look for them in better pool supplies stores everywhere or visit us at **www.taylortechnologies.com.**

ASCA

Taylor makes the only testing supplies recommended by the **American Swimming Coaches Association.**

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#5695

POOL & SPA WATER TESTS

1. Read precautions on all labels.
2. Keep test kit out of reach of children.
3. Store test kit in cool, dark place.
4. Replace reagents once each year.
5. Do not dispose of solutions in pool or spa.
6. Rinse cells/tubes before and after each test.
7. Obtain samples 18" (45 cm) below water surface.
8. Hold bottle vertically when dispensing.

Instr. #5870

Chlorine (Free, Combined, Total) / Total Bromine Test*

IDEAL FC
2-4 pools/3-5 spas
IDEAL Br
4-6 pools and spas

1. Rinse and fill chlorine/bromine cell to mark with water to be tested.
2. Add 5 drops R-0001 and 5 drops R-0002. Cap and invert to mix.
3. Match color with color standard. Record as parts per million (ppm) free chlorine (FC) or total bromine (Br). For chlorine: See treatment table for adjustment or go to website. For bromine: See manufacturer's instructions for adjustment. For total chlorine: See Step 4.
4. Add 5 drops R-0003. Cap and invert to mix.
5. Match color immediately. Record as ppm total chlorine (TC).
6. Subtract FC from TC. Record as ppm combined chlorine (CC). Formula: TC - FC = CC
   Superchlorinate to breakpoint to eliminate CC. Dosage equals 10 times the amount of CC.

pH Test*

IDEAL
7.2-7.8

1. Rinse and fill pH cell to mark with water to be tested.
2. Add 5 drops R-0014. Cap and invert to mix.
3. Match color with color standard. Record as pH units and save sample if pH needs adjustment. If sample color is between two values, pH is average of the two. To LOWER pH: See acid demand test below or go to website. To RAISE pH: See base demand test below or go to website.

Acid Demand Test

1. Use treated sample from pH test.
2. Add R-0015 dropwise. After each drop, count, mix, and compare with color standards until desired pH is matched. See treatment tables to continue.

Base Demand Test

1. Use treated sample from pH test.
2. Add R-0016 dropwise. After each drop, count, mix, and compare with color standards until desired pH is matched. See treatment table to continue.

Total Alkalinity (TA) Test*

IDEAL
80-120

1. Rinse and fill sample tube (#9198) to 25 mL mark with water to be tested.
2. Add 2 drops R-0007. Swirl to mix.
3. Add 5 drops R-0008. Swirl to mix. Sample should turn green.
4. Add R-0009 dropwise. After each drop, count and swirl to mix until color changes from green to red.
5. Multiply drops in Step 4 by 10. Record as parts per million (ppm) total alkalinity as calcium carbonate. See treatment tables for adjustment or go to website.

Calcium Hardness (CH) Test*

IDEAL
200-400 pools/
150-250 spas

1. Rinse and fill sample tube (#9198) to 25 mL mark with water to be tested.
2. Add 20 drops R-0010. Swirl to mix.
3. Add 5 drops R-0011L. Swirl to mix. If calcium hardness is present, sample will turn red.
4. Add R-0012 dropwise. After each drop, count and swirl to mix until color changes from red to blue.
5. Multiply drops in Step 4 by 10. Record as parts per million (ppm) calcium hardness as calcium carbonate. To RAISE: See treatment table for adjustment or go to website. To LOWER: Partially drain and refill with fresh water of lower hardness.

Cyanuric Acid (CYA) Test

IDEAL
30-50

1. Rinse and fill CYA dispensing bottle (#9191) to 7 mL mark with water to be tested.
2. Add R-0013 to 14 mL mark. Cap and mix for 30 seconds.
3. Slowly transfer cloudy solution to CYA view tube (#9197) until black dot on bottom just disappears when viewed from the top.
4. Read tube at liquid level. Record as parts per million (ppm) of cyanuric acid. To lower CYA either partially drain water and refill with fresh, or switch to unstabilized chlorine for a time.

* When test values for free chlorine or total bromine are within the ideal ranges shown above, water should be adequately SANITIZED.
** When test values for pH, TA, and CH are within the ideal ranges shown above, water should be BALANCED.
When adjustments are needed, see treatment tables on reverse or visit www.swim-care.com and plug in your pool test results for recommendations.

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TROUBLE PREVENTION CHART

SYMPTOM	*CAUSE*	*POTENTIAL SOLUTION*
Plaster etching, concrete pitting, grout dissolving.	Imbalanced water.	Have pH, total alkalinity, & calcium hardness levels tested. Balance water with treatment chemicals recommended by your supplier.
Scale on walls & fixtures. (Common in new inground pools.)		
Corrosion of metal fixtures in contact with pool water. Rust & copper stains.	Imbalanced water.	Have pH, total alkalinity, & calcium hardness levels tested. Balance water with treatment chemicals recommended by your supplier. Add chelating or sequestering agent per instructions to prevent more stains.
Bleached hair or bathing suits. Eye irritation.	Excessive chlorine.	Add sodium thiosulfate or sodium sulfite to neutralize.
Eye irritation &/or itchy skin. Water has foul odor. Complaints of "too much chlorine" in water.	High combined chlorine, low free chlorine.	Adjust pH to 7.2-7.8.* Perform breakpoint chlorination to eliminate combined chlorine. Do not reenter water until free chlorine level drops below 5 ppm.
Skin/eye irritation.	Improper pH.	Adjust pH to 7.2-7.8.*

SYMPTOM	*CAUSE*	*POTENTIAL SOLUTION*
Hazy, cloudy water. No sparkle.	Early algae growth.	Superchlorinate or shock.
	Poor filtration.	Check filter for proper operation.
	High pH.	Lower pH to 7.2-7.8.*
	High total alkalinity.	Lower total alkalinity to 80-120 ppm.
Red-brown water.	Iron.	Seek expert advice on source of metals & treatment solution.
Purple-black water.	Manganese.	
Blue-green water.	Copper.	
Green, slippery pool surfaces & cloudy or green water. Black spotty patches on pool surfaces. Yellow powdery deposits on shady side of pool.	Algae.	Adjust pH to 7.2-7.8.* Superchlorinate to 30 ppm. Concrete: Brush sides & bottom with stainless steel brush. Vinyl liner: Use soft nylon brush. Repeat if necessary. Use algaecides.

* Always bring total alkalinity into recommended range before adjusting pH.

TREATMENT TABLES

Treatment table values below are based on specific strength chemicals (e.g., sodium carbonate, 100% or calcium chloride, 77%). If the specific treatment chemical used in your pool or spa is a different strength, **you must adjust the treatment amount given.** You can also get pool water treatment recommendations by plugging your test results into the water analysis program available at **www.swim-care.com**.

To Raise Chlorine Level by 1 ppm

Volume of Water (gallons / liters)	% AVAILABLE CHLORINE IN PRODUCT					
	10%	35%	45%	65%	75%	90%
100 gal / 400 L	0.13 fl oz / 4.00 mL	0.04 oz / 1.14 g	0.03 oz / 0.89 g	0.02 oz / 0.62 g	0.02 oz / 0.56 g	0.02 oz / 0.44 g
1,000 gal / 4,000 L	1.28 fl oz / 40.0 mL	0.38 oz / 11.4 g	0.30 oz / 8.89 g	0.21 oz / 6.15 g	0.20 oz / 5.63 g	0.15 oz / 4.44 g
10,000 gal / 40,000 L	12.8 fl oz / 400 mL	3.82 oz / 114 g	2.97 oz / 88.9 g	2.05 oz / 61.5 g	1.77 oz / 56.3 g	1.48 oz / 44.4 g

Superchlorination for Algae Removal (30 ppm Chlorine)

Volume of Water (gallons / liters)	% AVAILABLE CHLORINE IN PRODUCT					
	10%	35%	45%	65%	75%	90%
100 gal / 400 L	3.84 fl oz / 120 mL	1.14 oz / 34.3 g	0.89 oz / 26.7 g	0.62 oz / 18.5 g	0.57 oz / 17.0 g	0.45 oz / 13.3 g
1,000 gal / 4,000 L	1.20 qt / 1.20 L	11.4 oz / 343 g	8.90 oz / 267 g	6.17 oz / 185 g	5.66 oz / 170 g	4.45 oz / 133 g
10,000 gal / 40,000 L	3.00 gal / 12.0 L	7.15 lb / 3.43 kg	5.56 lb / 2.67 kg	3.85 lb / 1.85 kg	3.53 lb / 1.70 kg	2.78 lb / 1.33 kg

To Raise pH with Soda Ash (Sodium Carbonate – 100%)

Volume of Water (gallons / liters)	DROPS OF BASE DEMAND REAGENT ADDED				
	1	2	3	4	5
100 gal / 400 L	0.05 oz / 1.54 g	0.10 oz / 3.07 g	0.15 oz / 4.61 g	0.21 oz / 6.14 g	0.26 oz / 7.68 g
1,000 gal / 4,000 L	0.51 oz / 15.4 g	1.03 oz / 30.7 g	1.54 oz / 46.1 g	2.05 oz / 61.4 g	2.56 oz / 76.8 g
10,000 gal / 40,000 L	5.13 oz / 154 g	10.3 oz / 307 g	15.4 oz / 461 g	1.28 lb / 614 g	1.60 lb / 768 g

To Lower pH with Muriatic Acid (Hydrochloric Acid – 20° Baumé)

Volume of Water (gallons / liters)	DROPS OF ACID DEMAND REAGENT ADDED				
	1	2	3	4	5
100 gal / 400 L	0.09 fl oz / 2.86 mL	0.18 fl oz / 5.73 mL	0.28 fl oz / 8.59 mL	0.37 fl oz / 11.5 mL	0.46 fl oz / 14.3 mL
1,000 gal / 4,000 L	0.92 fl oz / 28.6 mL	1.83 fl oz / 57.3 mL	2.75 fl oz / 85.9 mL	3.67 fl oz / 115 mL	4.58 fl oz / 143 mL
10,000 gal / 40,000 L	9.16 fl oz / 286 mL	1.15 pt / 573 mL	1.72 pt / 859 mL	1.15 qt / 1.15 L	1.43 qt / 1.43 L

To Lower pH with Dry Acid (Sodium Bisulfate – 93.2%)

Volume of Water (gallons / liters)	DROPS OF ACID DEMAND REAGENT ADDED				
	1	2	3	4	5
100 gal / 400 L	0.12 oz / 3.69 g	0.25 oz / 7.38 g	0.37 oz / 11.1 g	0.49 oz / 14.8 g	0.62 oz / 18.5 g
1,000 gal / 4,000 L	1.23 oz / 36.9 g	2.46 oz / 73.8 g	3.70 oz / 111 g	4.93 oz / 148 g	6.16 oz / 185 g
10,000 gal / 40,000 L	12.3 oz / 369 g	1.54 lb / 738 g	2.31 lb / 1.11 kg	3.08 lb / 1.48 kg	3.85 lb / 1.85 kg

To Raise Total Alkalinity with Baking Soda (Sodium Bicarbonate – 100%)

Volume of Water (gallons / liters)	DESIRED INCREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.22 oz / 6.71 g	0.45 oz / 13.4 g	0.67 oz / 20.1 g	0.90 oz / 26.9 g	1.12 oz / 33.6 g
1,000 gal / 4,000 L	2.24 oz / 67.1 g	4.48 oz / 134 g	6.72 oz / 201 g	8.97 oz / 269 g	11.2 oz / 336 g
10,000 gal / 40,000 L	1.40 lb / 671 g	2.80 lb / 1.34 kg	4.20 lb / 2.01 kg	5.60 lb / 2.69 kg	7.00 lb / 3.36 kg

To Lower Total Alkalinity with Muriatic Acid (Hydrochloric Acid – 20° Baumé)

Volume of Water (gallons / liters)	DESIRED DECREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.26 fl oz / 7.99 mL	0.51 fl oz / 16.0 mL	0.77 fl oz / 24.0 mL	1.02 fl oz / 32.0 mL	1.28 fl oz / 39.9 mL
1,000 gal / 4,000 L	2.56 fl oz / 79.9 mL	5.11 fl oz / 160 mL	7.67 fl oz / 240 mL	10.2 fl oz / 320 mL	12.8 fl oz / 399 mL
10,000 gal / 40,000 L	1.60 pt / 799 mL	1.60 qt / 1.60 L	2.40 qt / 2.40 L	3.20 qt / 3.20 L	3.99 qt / 3.99 L

To Lower Total Alkalinity with Dry Acid (Sodium Bisulfate – 93.2%)

Volume of Water (gallons / liters)	DESIRED DECREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.34 oz / 10.3 g	0.69 oz / 20.6 g	1.03 oz / 30.9 g	1.37 oz / 41.2 g	1.71 oz / 51.5 g
1,000 gal / 4,000 L	3.44 oz / 103 g	6.87 oz / 206 g	10.3 oz / 309 g	13.7 oz / 412 g	1.07 lb / 515 g
10,000 gal / 40,000 L	2.15 lb / 1.03 kg	4.30 lb / 2.06 kg	6.45 lb / 3.09 kg	8.59 lb / 4.12 kg	10.7 lb / 5.15 kg

To Raise Calcium Hardness with Calcium Chloride – 77%

Volume of Water (gallons / liters)	DESIRED INCREASE IN PARTS PER MILLION (PPM)				
	10 ppm	20 ppm	30 ppm	40 ppm	50 ppm
100 gal / 400 L	0.19 oz / 5.76 g	0.39 oz / 11.5 g	0.58 oz / 17.3 g	0.77 oz / 23.0 g	0.96 oz / 28.8 g
1,000 gal / 4,000 L	1.92 oz / 57.6 g	3.85 oz / 115 g	5.77 oz / 173 g	7.69 oz / 230 g	9.61 oz / 288 g
10,000 gal / 40,000 L	1.20 lb / 576 g	2.40 lb / 1.15 kg	3.61 lb / 1.73 kg	4.81 lb / 2.30 kg	6.01 lb / 2.88 kg